KEITHLEY

# INSTRUCTION MANUAL
## Model 1793/6423
## IEEE Standard 488 Output

**Keithley Instruments, Inc.**
28775 Aurora Road/Cleveland, Ohio 44139/[216] 248-0400/Telex: 98-5469

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# INSTRUCTION MANUAL

# MODEL 1793/6423

# IEEE STANDARD 488 OUTPUT

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# SECTION 1. GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. The Model 1793/6423 is an IEEE Standard 488-1978 Bus Interface option that provides the logic and control functions necessary to interface the Keithley Models 177, 179 and 179-20A Digital Multimeters, the Model 480 Picoammeter, and the Model 642 Electrometer. It may be either field or factory installed. The combination of the Model 1793/6423 and its host DMM, Picoammeter or Electrometer can operate in either the TALK ONLY or ADDRESSABLE mode, as determined by the setting of an internal switch. In the TALK ONLY mode, it can send data to an IEEE compatible listener at one of seven switch selectable rates, from 2.5 readings/second to 1 reading/hour. In the ADDRESSABLE mode, readings may be triggered or non-triggered, depending on whether its odd or even address is received from the IEEE controller. The internal switch settings determine the reading rate for the TALK ONLY mode, and its address when in the ADDRESSABLE mode. The Model 1793/6423 provides an output of 4-1/2 digit ASCII data, sign, and overrange.

## 1-3. COMPATIBILITY.

1-4. The Model 1793 is compatible with the following Keithley instruments:

a) Model 177 DMM Serial Number 16500 and above.

b) Models 179 and 179-20A DMM Serial Number 24000 and above.

c) Model 480 Picoammeter Serial Number 12000 and above. NOTE: The first 3-1/2 digits of the output are the same as the 480 display.

1-5. The Model 6423 is compatible with the Model 642 Electrometer Serial Number 53402 and above.

## 1-6. WARRANTY INFORMATION.

1-7. The Warranty is given on the inside front cover of this Instruction Manual. If there is a need to exercise the warranty, contact the Keithley Representative in your area to determine the proper action to be taken. Keithley maintains service facilities in the United Kingdom and West Germany, as well as in the United States. Check the inside front cover of this Manual for addresses.

## 1-8. CHANGE NOTICES.

1-9. Improvements or changes to the equipment which occur after printing of the Instruction Manual will be explained on a Change Notice sheet attached to the inside back cover.

## 1-10. SAFETY SYMBOLS.

1-11. Safety symbols used in this manual are as follows:

**IMPORTANT**

The symbol may be found in various places in this manual. Carefully read the associated CAUTION statements with regard to proper use and handling of the equipment. Damage to the equipment may occur if these precautions are ignored.

This symbol may be found in various places in this manual. This symbol indicates those areas on the equipment which are potential shock hazards. Carefully read the associated WARNING statements with regard to proper use and handling of the equipment. Serious personal injury may result if these precautions are ignored.

## 1-12. SPECIFICATIONS.

1-13. Detailed specifications for the Model 1793/6423 are listed in Table 1-2. These specifications are defined as the performance standards or limits against which the Model 1793/6423 is tested. Table 1-1 lists general operating characteristics of the Model 1793/6423. These characteristics are not specifications, but are typical operating characteristics or constraints which are included as additional information for the user.

TABLE 1-1
General Operating Characteristics

| |
|---|
| 1. The 1793/6423 digital output low (pins 12 and 18 thru 24 on J501) is intended to be connected to a ground point within 30VRMS of earth ground. |
| 2. Common mode input to the meter shall not exceed $10^5$V•Hz to guarantee valid data output. |
| 3. 488 BUS outputs are open collector with Power Up/Power Down protection (No invalid information transmitted to the BUS). |
| 4. Maximum transfer rate for one entire reading (after being addressed) is 1msec. |

TABLE 1-2
Specifications, Model 1793/6423 IEEE-488 Output

**OUTPUT:** 4-1/2 digit ASCII data, sign, and overrange.

DATA FORMAT: - XXXXX CR LF

Sign (Plus implied)
Display
Terminator

OVERRANGE OUTPUT: ASCII "OVER" in place of "XXXXX"

**LOGIC LEVELS:** Meets all IEEE Std. 488-1978 specifications.

**MODES OF OPERATION:** (Selected by internal switches)

TALK ONLY: Allows user to connect meter to an IEEE-compatible listener. Data outputted at seven switch selectable rates from 2.5 rdgs/sec to 1 rdg/hr.

ADDRESSABLE: Allows user to connect meter to an IEEE-compatible controller. Address selected by internal switches. Non-Triggered addresses are even from 0 to 28. Triggered address is non-triggered address +1.

NON-TRIGGER: Upon receiving its non-trigger address, outputs the displayed reading

TRIGGER: Upon receiving its trigger address, initiates a single A-D conversion and outputs the reading 400 msec later.

**ISOLATION:** Digital outputs isolated from input circuitry ($10^{10}\Omega$, 40pF typ).

**ENVIRONMENT:**
Model 1793 Operate: 0 to 55°C, 0 to 80% RH.
Storage: -25 to +70°C.
Model 6423 Operate: 20 to 30°C, 0 to 70% RH.
Storage: -25 to +55°C.

**OUTPUT CONNECTOR:** 24-pin IEEE-488 standard connector.

**INSTALLATION:** Field installable, mounts within and powered from meter. Adds 0.6kg (1.3 lbs), 10 watts.

Model 1793 Precludes 1788, 1792 installation.
Model 6423 Precludes 6422, 6428 installation.

**ACCESSORIES AVAILABLE:** 1.8m (6 ft.) IEEE Cable Keithley Model 7008.

# SECTION 2. INITIAL PREPARATION.

## 2-1. INTRODUCTION.

2-2. This section provides information for incoming inspection, preparation for use, and installation of the Model 1793/6423.

## 2-3. UNPACKING AND INSPECTION.

2-4. The Model 1793/6423 was carefully inspected, both mechanically and electrically before shipment. Upon receiving your IEEE output option, unpack all items from the shipping container and check for any obvious damage which may have occured during transit. Report any damages to the shipping agent. Retain and use the original packaging materials if reshipment is required. The following items (Keithley Part No. in parentheses) are shipped with all orders of your option:

a. Model 1793

1) PC-524 Assembly (30370D)

2) Shield Assembly (30107C)

3) Replacement Top Cover (30409C)

4) A copy of this Instruction Manual

5) Separate Optional Cable (Model 7008), as ordered.

b. Model 6423

1) PC-524 Assembly (30494D)

2) Shield Assembly (30133B)

3) Back Panel Assembly (30496A)

4) A copy of this Instruction Manual

5) Separate Optional Cable (Model 7008), as ordered.

## 2-5. MODEL 1793 INSTALLATION.

2-6. The Model 1793 is installed internally in the Model 177, 179, 179-20A or 480 and is powered by its own line operated power supply. Installation of the Model 1793 precludes use of the Model 1788 Battery Pack and 1792 BCD Output. Refer to Figure 2-1 and install the Model 1793 as follows:

**WARNING**

Disconnect the line cord before removing the case cover.

a. Turn off power and disconnect line cord.

b. Turn the DMM bottom side up and loosen the four screws in the bottom cover.

c. Hold the top and bottom covers together to prevent their separation and turn the DMM over to the normal position.

d. Lift off the top cover and the calibration shield if installed. Remove the Model 1788 Battery Pack or Model 1792 BCD Option if installed. The four plastic spacers must remain in place on the upright studs projecting through the main printed circuit board.

**NOTE**

Do not discard the calibration shield. This shield must be installed during calibration, as described in the Instruction Manual for your instrument.

e. If the Model 1788 was removed, set the LINE/BAT switch on the main printed circuit board to the LINE position.

f. Set the Line Voltage Switch (S501) on the 1793 to the proper voltage (110V or 230V).

g. The 1793 is powered by the AC line. Disconnect J1003 from its mating receptacle on the instrument's mother board (J1005 on the Model 480), and reconnect to P1003A on the 1793. Connect J1003B of the 1793 to P1003 on the instrument's mother board (P1005 on the Model 480).

h. Connect P1008 to its mating recepticle on the printed circuit board (J1002 on the Model 480 and J1008 on the Models 177, 179, α 179-20A).

j. Install the Model 1793 in the instrument so that it rests on the plastic spacers. The ground clip must make contact with the upper side of the shield on the Model 1793.

k. Set up the DIP switch, S502, for the proper mode of operation and timing/address as explained in the Operating Instructions (paragraph 3-3).

l. Install the top cover that was shipped with the Model 1793. This cover has a hole to accommodate the connector of the Model 1793.

m. Save all removed parts for reinstallation in the event that the 1793 is to be removed at a later date.

## 2-7. MODEL 6423 INSTALLATION.

2-8. The Model 6423 is installed internally in the Model 642 Electrometer mainframe and is powered by its own line operated power supply. Installation of the Model 6423 precludes use of the Model 6422 BCD Output and the Model 6428 Battery Adapter. Refer to Figure 2-2 and install the Model 6423 as follows:

**WARNING**

Disconnect the line cord before removing the case cover.

a. Turn off power and disconnect the line cord.

b. Remove the four attaching screws and remove the top cover.

c. Remove and replace the back panel plate with the plate that is furnished with the Model 6423. (Remove the Model 6422 or 6428 if installed.)

d. Remove the front four attaching screws from the mother board and replace them with the metal spacers, as shown in Figure 2-2. These spacers may fit snugly and require use of a wrench to install them. Take care not to cross thread or tighten them too tight.

e. Connect P1008 to J1013 on the mother board. After making the connection, place the printed circuit board outside of the Model 642 so that there is no strain on the cable and the board will be out of the way during installation of the shield and spacers in the following steps.

f. Place the shield on the spacers and attach with the four screws, as shown. The printed circuit board will not fit properly unless the shield is installed with the nut plates on the bottom side and with the hole pattern positioned as illustrated.

g. Install the four spacers into the shield.

h. Place the printed circuit board on the spacers (component side down) and attach it with four screws.

i. Attach the output connector (J501) to the back panel plate using two No. 6 hex head bolts and two No. 6 kep nuts (see Component Layout 30494D - page 6- ).

j. Disconnect the AC power line at the mother board of the 642 (J/P 1006) and reconnect to P1003A of the 6423. Connect J1003B of the 6423 to P1006 of the 642.

k. Set the Line Voltage Switch (S501) on the 6423 to the proper line voltage (110V or 230V).

l. Set up the DIP switch, S502, for the proper mode of operation and timing/address as explained in the Operating Instructions (paragraph 3-3).

m. Reinstall the case top cover.

n. Save all removed parts for reinstallation in the event that the 6423 is to be removed at a later date.

## 2-9. MODEL 1793/6423 OUTPUT CONNECTOR.

2-10. The Model 1793/6423 uses a 24-pin connector (J501) which will interface with IEEE-488 1978 connector.

2-11. An optional cable accessory is available for interfacing the 1793/6423 with external equipment. The Model 7008 is a 1.8m (6 ft.) IEEE Cable.

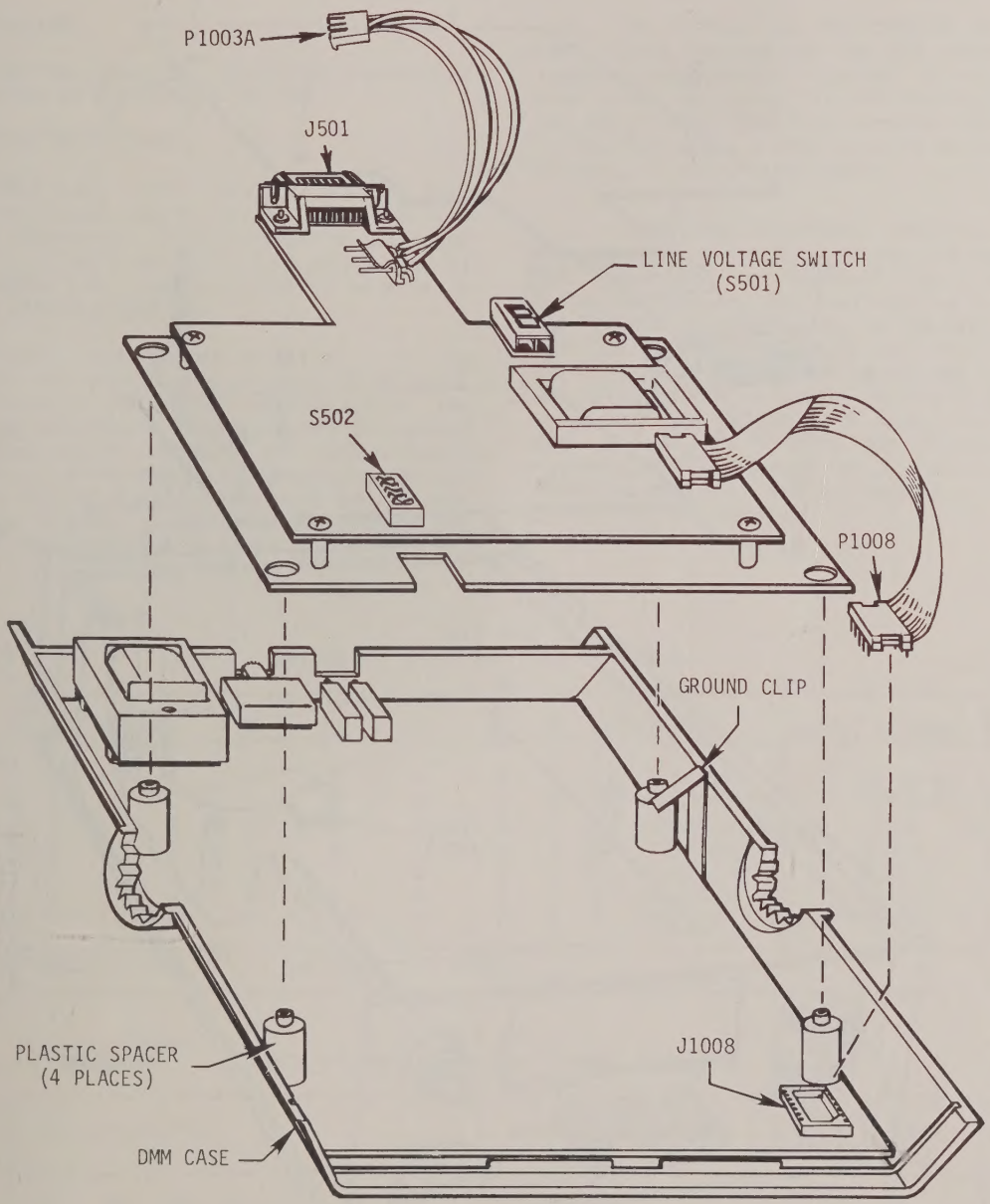



FIGURE 2-1. Installation of Model 1793

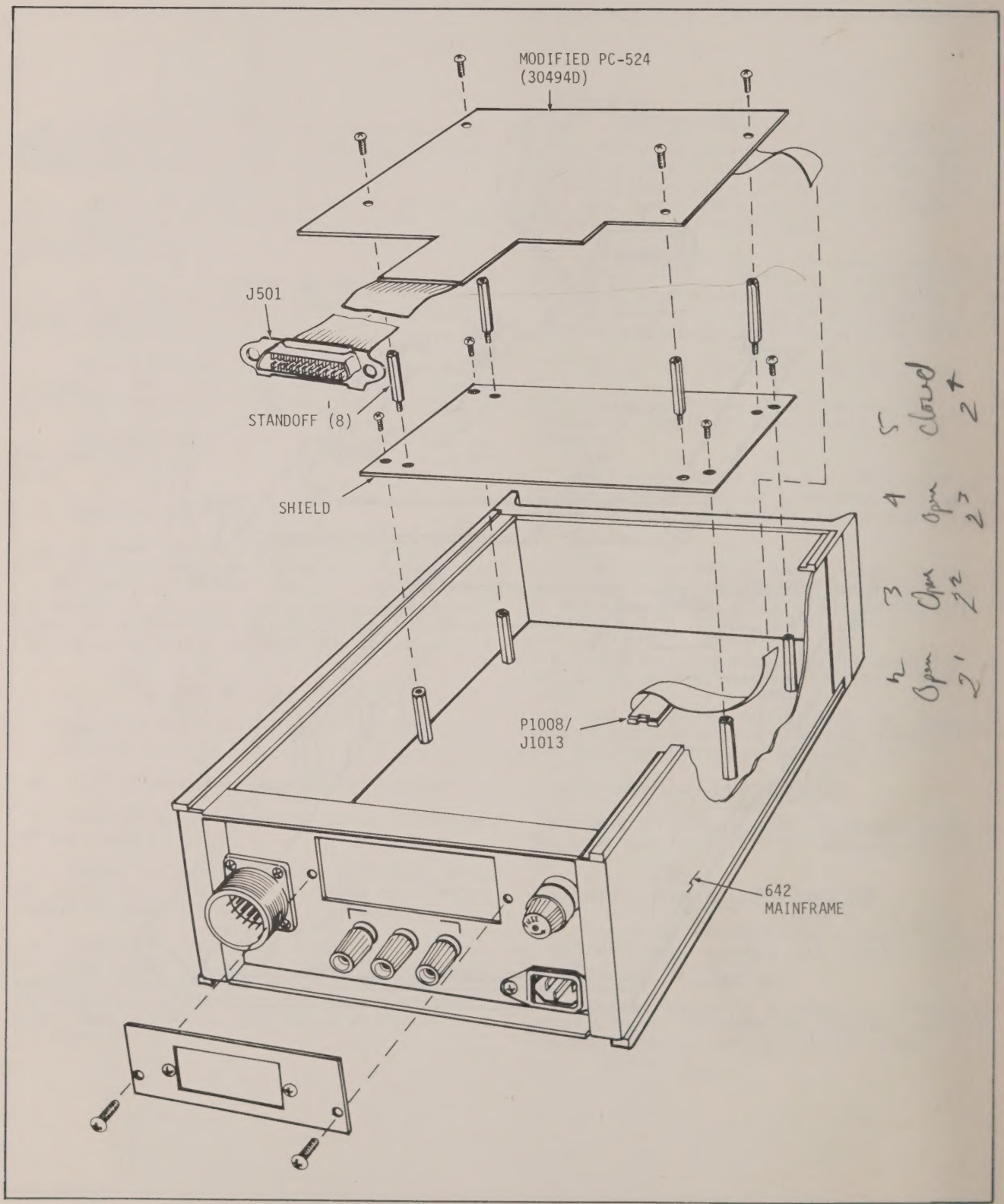



FIGURE 2-2. Installation of Model 6423.

# SECTION 3. OPERATION

## 3-1. INTRODUCTION.

3-2. This section provides information needed for proper operation of the Model 1793/6423.

## 3-3. OPERATING INSTRUCTIONS.

3-4. TALK ONLY mode - When switch 6 of S502 (see Figure 3-1) is closed, the interface is in the TALK ONLY mode of operation. In this mode the positions of switches 1, 2 and 3 determine the output rate as defined in Table 3-1. The positions of switches 4 and 5 do not affect operation.

3-5. ADDRESSABLE mode - When switch 6 is in the open position the interface is in the ADDRESSABLE mode. Switches 2 through 5 now determine the address of the interface. These switches correspond to the addresses $2^1$ through $2^4$ respectively. The even address corresponding to switches 2 through 5 is the NON-TRIGGER ADDRESS. The next odd address is the TRIGGER ADDRESS. Examples of NON-TRIGGER and TRIGGER ADDRESSES are shown in Table 3-2.

3-6. The ADDRESSABLE NON-TRIGGER mode sends the most recent reading on the BUS immediately after receiving its address. The A/D is always in the RUN mode after receiving its NON-TRIGGER ADDRESS. If the NON-TRIGGER ADDRESS is received while the A/D is in the HOLD mode, a reading won't be outputted until 400msec. (1 conversion) later.

3-7. When the interface receives its TRIGGER ADDRESS while the A/D is in the RUN mode, the present conversion is completed and 1 more complete conversion occurs. The last reading is outputted on the BUS and the A/D is now in the HOLD mode. Each time the TRIGGER ADDRESS is now received, a single A-D conversion will be triggered and 400msecs later the data will be outputted to the BUS. Table 3-3 shows the time delays when going from one address mode to another. If a NON-TRIGGER ADDRESS is received within 400msec. of a previous NON-TRIGGER ADDRESS, data will not be outputted until the new conversion is complete.

TABLE 3-1
Switch positions for TALK ONLY MODE.

| S7 | S6 | S5 | S4 | S3 | S2 | S1 | OUTPUT RATE | OUTPUT INTERVAL |
|---|---|---|---|---|---|---|---|---|
| X | 1 | X | X | Ø | Ø | Ø | 2.5 rdgs/sec | 400 msec |
| X | 1 | X | X | Ø | Ø | 1 | 25 rdgs/minute | 2.4 sec |
| X | 1 | X | X | Ø | 1 | Ø | 6 rdgs/minute | 10sec |
| X | 1 | X | X | Ø | 1 | 1 | 1 rdg/minute | 1 Min. |
| X | 1 | X | X | 1 | Ø | Ø | 12 rdgs/hour | 5 Min. |
| X | 1 | X | X | 1 | Ø | 1 | 4 rdgs/hour | 15 Min. |
| X | 1 | X | X | 1 | 1 | Ø | 1 rdg/hour | 60 Min. |

X=Don't Care 1=Closed Ø=Open

TABLE 3-2
Example of Non-Trigger and Trigger Addresses

| Switch Setting | | | | | | | Non-Trigger Address (always even) | Trigger Address (always odd) |
|---|---|---|---|---|---|---|---|---|
| S7 | S6 | S5 | S4 | S3 | S2 | S1 | | |
| X | Ø | Ø | Ø | Ø | 1 | X | 2 | 3 |
| X | Ø | 1 | Ø | Ø | Ø | X | 16 | 17 |
| X | Ø | 1 | 1 | Ø | Ø | X | 24 | 25 |
| X | Ø | Ø | Ø | Ø | Ø | X | Ø | 1 |

X=Don't Care 1=Closed Ø=Open

TABLE 3-3
Address To Address Time Delays

| CONDITION | A/D MODE BEFORE OUTPUT | A/D MODE AFTER OUTPUT | DELAY UNTIL BUS OUTPUT |
|---|---|---|---|
| POWER ON | Run | | |
| NON-TRIGGER ADDRESS RECEIVED | Run | Run | <1msec |
| TRIGGER ADDRESS RECEIVED | Run | Hold | 400-800msecs |
| TRIGGER ADDRESS RECEIVED | Hold | Hold | 400msec |
| NON-TRIGGER ADDRESS RECEIVED | Hold | Run | 400msec |
| NON-TRIGGER ADDRESS RECEIVED | Run | Run | <1msec if >400msec since last address. 1 to 400msec if <400msec since last address |

3-8. **Secondary Addressing.** Due to settling time of the A-D converter, it may be necessary to use the Secondary Addressing mode of the 1793/6423 to achieve triggered readings within the rated accuracy of the instrument.

3-9. Secondary Addressing may also be used to change the terminator from a CR-LF to LF-CR to be compatible with all controllers (e.g. DEC 11V03). Table 3-4 defines the Secondary Addresses.

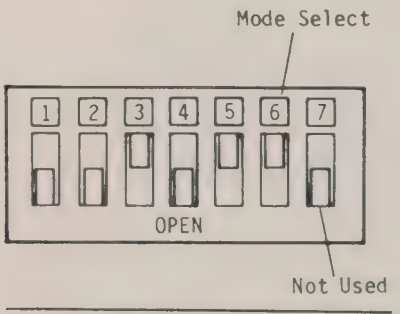



FIGURE 3-1. S502

3-10. If no Secondary Address is sent, the default condition is Secondary Address Ø. The Secondary Address must be present within 1msec after receiving the primary address.

TABLE 3-4
Secondary Addresses

| Secondary Address | Triggered Period | Terminator |
|---|---|---|
| Ø | 400msec | CR-LF |
| 1 | 400msec | LF-CR |
| 2 | 1.2 sec | CR-LF |
| 3 | 1.2 sec | LF-CR |

3-11. **Using the 1793/6423 with the PET Computer.** The standard PET Computer comes with an IEEE 488 Port which can be used as a low cost controller. A limitation of the PET, however, is that once a device has been addressed to talk, it must respond within 65msec. If a response is not received within this time, the PET will proceed to the next BASIC instruction. Table 3-5 is a suggested method to circumvent this limitation of the PET.

3-12. To get a 400msec triggered reading with program in Table 3-5, change the address to 25. To get a 1.2 sec. triggered reading, add the FOR NEXT loop as shown in Table 3-6.

3-13. It is not recommended to use Secondary Addressing with the 1793/6423 and the PET due to the timing limitation.

TABLE 3-5
Program for the 1793/6423 and the PET.

| BASIC INSTRUCTIONS | REMARKS |
|---|---|
| 1Ø OPEN 1,24 | 1, is the logical file number. 24 is the Primary Address (can be from 4 to 29). |
| 2Ø INPUT#1,D$ | DATA is inputted to file 1 from device with Primary Address 24. D$ is the name given to the incoming data. |
| 3Ø IF ST=2 THEN 2Ø | ST is the status bit; TIME OUT Read error. The program remains in this loop until data is received. |
| 4Ø PRINT D$ | The incoming data is printed on the CRT. |

TABLE 3-6
Program for a 1.2 Sec. Triggered Reading

| BASIC INSTRUCTION | REMARKS |
|---|---|
| 1Ø OPEN 1,25 | * |
| 15 FOR N = 1 to 3 | This loop gets 3 readings, but only outputs the latest reading. |
| 2Ø INPUT#1,D$ | * |
| 3Ø IF ST=2 THEN 2Ø | * |
| 35 NEXT N | End of loop. |
| 4Ø PRINT D$ | * |

*Remarks same as Table 3-5

# SECTION 4. THEORY OF OPERATION.

## 4-1. INTRODUCTION.

4-2. This section contains functional descriptions of the Model 1793/6423 circuitry. The overall operation of the 1793/6423 is depicted by the flow diagram in Figure 4-1.

4-3. The 1793/6423 is controlled by a 6802µP, a PIA and 512 bytes of program memory. The µP contains an internal oscillator and 128 bytes of RAM. An external 4MHz crystal is provided for the oscillator. The PIA provides the I/O necessary to convert isolated serial data from the instrument to parallel ASCII Data. It also performs the handshaking necessary to control the IEEE BUS. The program is stored in 512 bytes of EPROM; the first 504 bytes are at address 8000 to 81F8 Hex, the last 8 bytes are the interrupt vectors addressed from FFF8 to FFFF Hex.

## 4-4. POWER SUPPLY.

4-5. The 1793/6423 has its own power supply derived from AC line voltage, relay-controlled by the instrument's 5-volt power supply. When the instrument is turned on, the relay activates the interface, an RC circuit (56KΩ, 4.7µF) holds the microprocessor and PIA reset line below .8 volts for the required 20msec after Vcc reaches 5 volts. Once the reset line becomes approximately 4 volts, the microprocessor begins executing instructions.

## 4-6. PARALLEL TO SERIAL CONVERSION.

4-7. Parallel BCD data from the instrument is converted to serial data which is sent over one opto-isolator to the processor. A strobe line provided by the A/D pulses low for each of the 5 BCD digits when an A/D conversion is complete (every 400 msecs).

4-8. The 4021 8 stage shift register inputs parallel or serial data, depending on the state of the P/$\overline{S}$ line. The 4018 divides the 100KHz clock from the instrument down to 10KHz to clock the shift register. When new BCD is not being presented (the strobe line remaining Low), the P/$\overline{S}$ line is low and the data presented at the serial input is shifted out Q8. The serial input is tied low so that Q8 always remains low when new BCD data is not present.

4-9. When new BCD is present (every 400 msecs), the P/$\overline{S}$ line goes high as a result of the strobe pulsing high. This causes the data present at P1 - P8 to be latched in the shift register and shifted out of Q8 at a 10 KHz rate.

4-10. The first bit shifted out is P8 which is permanently tied low. The next bit P7 is tied high and is used as a sync bit to signal the processor that BCD data will immediately follow. Bits P6, P5, P4 and P3 are the BCD code for a single digit, beginning with the most significant digit. P2 and P1 contain the sign and overrange information.

4-11. Three inverters of U502 buffer Q8 to provide the current sink necessary to drive the opto LED. The data opto-isolator is used in the emitter follower configuration to provide a uniform turn-on, turn-off time (approx. 20 µsec). Since the data is being sent asynchronously, the absolute turn-on, turn-off times are not critical. A timing diagram showing Parallel to Serial Conversions is given in Figure 4-2.

## 4-12. SERIAL TO PARALLEL CONVERSION.

4-13. The processor looks at the serial data from the opto and loops until the data goes high (the sync bit P7). It then looks at the opto output at 100 µsec. (1/10KHz) intervals to sense the serial data. After P1 (the overrange bit) has been received, the processor waits for another sync bit. This process continues for 10 msecs until all five digits of the latest reading are selected.

## 4-14. BUS OPERATION.

4-15. At turn-on of the instruments, or if an IFC (interface clear) is executed, the processor reads the DIP switches through the U513 tri-state buffers.

## 4-16. ADDRESS ACCEPTANCE.

4-17. The process of the 1793/6423 accepting its address from the interface is as follows:

a. The controller sets DAV HIGH and ATN low which clocks a Ø to the Q output of the D flip-flop. This sets MDAC low and NRFD high indicating to the controller that the data has not yet been accepted. The ATM going to low also programs the 3446 BUS DRIVER for NDAC and NRFD to be sent on the BUS, and DAV to be received from the BUS.

b. The µP then reads the address being sent through the U504 BUS TRANSCEIVER on the PIA I/O BUS. It then presets the flip-flop which sets NDAC high and NRFD low to indicate that the data has been accepted.

c. After all listeners on the BUS have accepted the address, the DAV line will go low indicating that the data on the BUS is no longer valid.

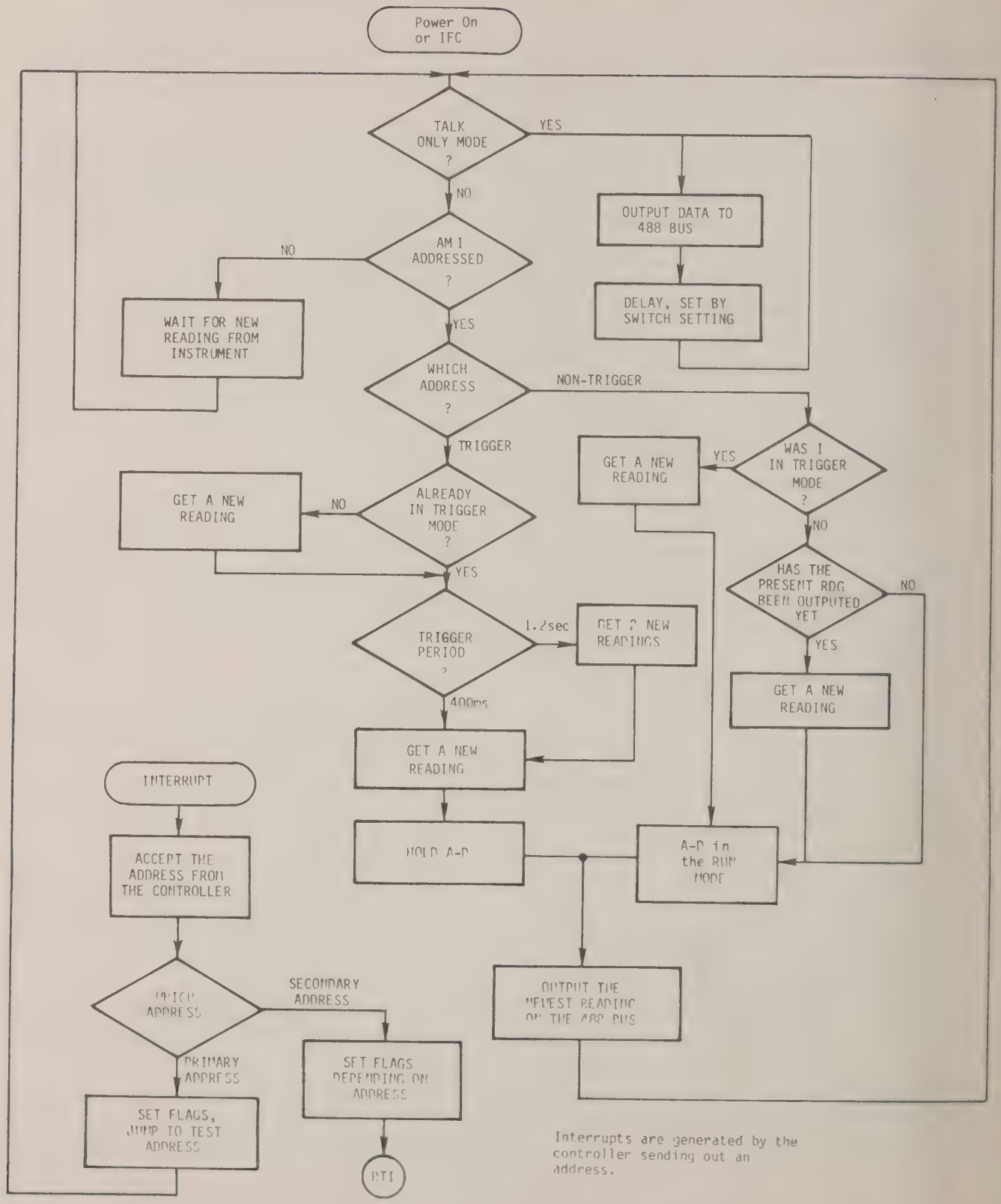



FIGURE 4-1. 1793/6423 Flow Diagram

4-18. DATA SENDING.

4-19. If the address received corresponds to the switch settings, the interface will send the latest reading on the BUS. The process of sending data on the BUS is as follows:

a. Set PB4 high to put U504 in the send mode and program NDAC and NRFD as inputs and DAV as an output.

b. Set the DAV line high to indicate it to all listeners that data is not yet valid.

c. Present valid data on the U504 BUS Driver.

d. The NRFD line is sensed until it goes high indicating that all listeners are ready for data.

e. DAV is made low to indicate that the data is now valid.

f. The NDAC line is sensed until it goes high indicating that all listeners have accepted the data.

g. DAV is set high to indicate the data is no longer valid.

Eight of these handshake procedures are necessary to send 1 complete reading over the BUS (sign, 5 digits, carriage return, line feed). When the IFC line is made low by a controller, a non-maskable interrupt will be executed which will put the interface into a TALKER IDLE STATE.

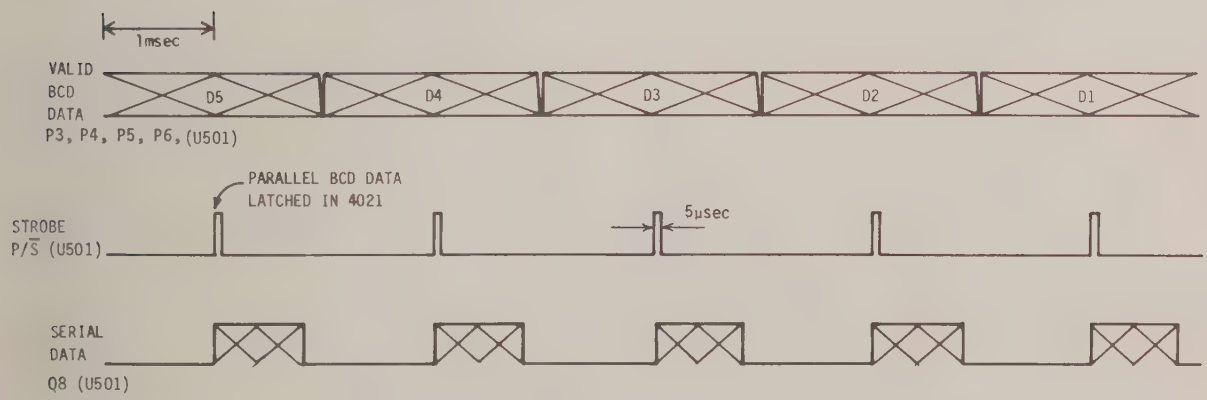



FIGURE 4-2. Timing Diagram

# SECTION 5. MAINTENANCE.

## 5-1. INTRODUCTION.

5-2. This section contains test point data, a verification procedure, and special handling procedures for static sensitive devices of the 1793/6423.

## 5-3. TEST POINT DATA.

5-4. The Model 1793/6423 has 4 test points that can be used for troubleshooting or confidence testing. Test points are described in Table 5-1. Test points are accessible by removing the instrument top cover as described in the installation procedure. The test points are labeled on the 1793/6423 PC-Board.

## 5-5. 1793/6423 VERIFICATION PROCEDURE.

5-6. After the 1793/6423 has been properly installed, its operation can be verified for both the ADDRESSABLE and TALK ONLY modes of operation.

## 5-7. ADDRESSABLE mode verification.

a. Disconnect the instrument's line cord and set the 1793/6423 for the ADDRESSABLE mode. Address selection is described in the Operating Instructions (par. 3-5).

b. Connect the 1793/6423 to a controller and apply power to the instrument.

c. Address the 1793/6423 to Talk with it's even NON-TRIGGER ADDRESS. Confirm that the reading received by the controller is the same as the instrument's displayed reading (less decimal point).

d. Address the 1793/6423 with it's odd TRIGGER ADDRESS. Note that the data is delayed before being received by the controller (400 to 800 msec.). Again, verify that the controller's reading agrees with the instrument's reading.

## 5-8. TALK ONLY mode verification.

a. Set the 1793/6423 in the TALK ONLY mode and select a desired output rate as explained in the Operator's Instructions (par. 3-4).

b. Connect the 1793/6423 to a listener, such as a printer, and verify that the output rate corresponds to the switch settings. Also, verify that the data agrees with the instrument's reading.

TABLE 5-1
Test Point Data

| Test Point | Signal | Reference |
|---|---|---|
| +5V | +5V Supply ±250mV | 1793/6423 COM |
| TP1 | STROBE - pulsed high 5 times (1 for each digit) every 400 msec. The 5 pulses are 2 msec. apart. Refer to timing diagram for STROBE (Figure 4-2). | Instrument Input Low |
| TP2 | ISOLATED SERIAL DATA - Approximately 9 msec. of positive going pulses occuring at 400 msec. intervals. The number of pulses is dependent on the displayed reading. (See Figure 5-1) | 1793/6423 COM |
| TP3 | The system clock (Ø2) is a 1MHz, 0 to 4V square wave. | 1793/6423 COM |
| Test Conditions: Instruments and 1793/6423 Turned On. No Controller attached. | | |

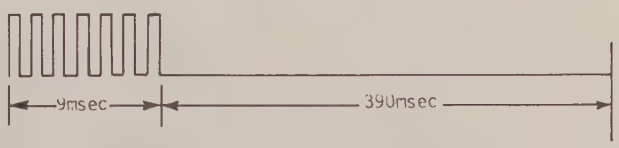



FIGURE 5-1. Isolated Serial Data

## 5-9. SPECIAL HANDLING OF STATIC SENSITIVE DEVICES.

5-10. CMOS and MOS devices are designed to function at very high impedance levels for low power consumption. For this reason, a normal static charge build up on your person or clothing can be sufficient to destroy these devices. The following steps list the static sensitive devices in your Model 1793/6423 and provide instructions on how to avoid damaging them when they must be removed/replaced.

a. Static sensitive devices:

| Keithley Part No. | Reference Designation |
|---|---|
| IC-130 | U501 |
| IC-106 | U502 |
| IC-145 | U503 |
| IC-153 | U507 |
| LSI-8 | U509 |
| LSI-18 | U511 |

b. The above integrated circuits should be handled and transported only in protective containers. Typically they will be received in metal tubes or static protective foam. Keep the devices in their original containers until ready for use.

c. Remove the devices from their protective containers only at a properly grounded work bench or table, and only after grounding yourself by using a wrist strap.

d. Handle the devices only by the body. Do not touch the pins.

NOTE

P1008 is shipped with a piece of conductive foam covering the pins to prevent static damage. This conductive foam should be replaced if you disconnect P1008 to remove the 1793/6423 from its host instrument.

e. Any printed circuit board into which a device is to be inserted must also be grounded to the bench or table.

f. Use only anti-static type solder suckers.

g. Use only grounded tip soldering irons.

h. After soldering the device into the board, or properly inserting it into the mating receptacle, the device is adequately protected and normal handling can be resumed.

# SECTION 6. REPLACEABLE PARTS.

## 6-1. GENERAL.

6-2. This section contains information for ordering replacement parts. The Replaceable Parts List (Table 6-1) is arranged in alphabetical order of the Circuit Designations of the components. A Cross-Reference List of Manufacturers, containing their address, is given in Table 6-2.

## 6-3. ORDERING INFORMATION.

6-4. To place an order, or to obtain information concerning replacement parts, contact your Keithley representative or the Factory. See the inside front cover for addresses. When ordering, include the following information.

a. Equipment Model Number.

b. Part Description.

c. Circuit Designation (if applicable).

d. Keithley Part Number.

## 6-5. SCHEMATIC.

6-6. Model 1793/6423; Schematic No. 30386D, Page

## 6-7. COMPONENT LAYOUTS.

6-8. Physical locations of parts are shown in the following component layouts.

TABLE 6-1
Replaceable Parts List

| Circuit Desig. | Description | Schematic Location | PC-Board Location | | Mfr. Code | Mfr. Desig. | Keithley Part No. |
|---|---|---|---|---|---|---|---|
| | | | 1793 | 6423 | | | |
| AT501 | IC, Optically-Coupled Isolator | C-6 | E-3 | F-3 | F-I | FCD 820 | IC-82 |
| AT502 | IC, Optically-Coupled Isolator | C-5 | E-3 | F-3 | F-I | FCD 820 | IC-82 |
| C501 | Cap, 4.7µF, 35V, EAL | A-4 | D-2 | E-2 | ITT | TAPA 75 4.7µFK20 | C-179-4.7 |
| C502 | Cap, 4700µF, 16V, EAL | C-3 | D-3 | E-3 | CAI | CSD4700-16-1 | C-290-4700 |
| C503 | Cap, 0.1µF, 16V, CerD | G-3 | C-4 | D-4 | CLB | UK16-104 | C-238-.1 |
| C504 | Cap, 0.1µF, 16V, CerD | E-3 | D-4 | E-4 | CLB | UK16-104 | C-238-.1 |
| C505 | Cap, 0.1µF, 16V, CerD | D-4 | D-4 | E-4 | CLB | UK16-104 | C-238-.1 |
| C506 | Cap, 0.1µF, 16V, CerD | F-1 | D-4 | E-4 | CLB | UK16-104 | C-238-.1 |
| C507 | Cap, 22pF, 500V, CerD | D-5 | B-5 | D-5 | CLB | DD220 | C-22-22p |
| C508 | Cap, 22pF, 500V, CerD | D-5 | C-5 | D-5 | CLB | DD220 | C-22-22p |
| C509 | Cap, 4.7µF, 35V, EAL | E-5 | D-5 | E-5 | ITT | TAPA 75 4.7µFK20 | C-179-4.7 |
| C510 | Cap, 0.02µF, 500V, CerD | B-3 | B-3 | C-3 | ERI | 811-00025 U0203M | C-22-.02 |
| CR501 | Bridge Rectifier, Silicon | B-3 | D-3 | E-3 | G-I | W04-M | RF-46 |
| CR502 | Diode, Silicon, 75mA, 75V | B-4 | C-3 | D-3 | T-I | IN914 | RF-28 |
| CR503 | Diode, Silicon, 75mA, 75V | H-4 | C-3 | D-3 | T-I | IN914 | RF-28 |
| CR504 | Diode, Silicon, 75mA, 75V | H-5 | C-3 | B-3 | T-I | IN914 | RF-28 |
| CR505 | Diode, Silicon, 75mA, 75V | E-5 | D-5 | E-5 | T-I | IN914 | RF-28 |
| F501 | Fuse, Slo-Blo, 1/8A, 250V, 3AG | B-2 | B-3 | C-3 | BUS | MDL | FU-20 |

TABLE 6-1
Replaceable Parts List (Cont'd)

| Circuit Desig. | Description | Schematic Location | PC-Board Location | | Mfr. Code | Mfr. Desig. | Keithley Part No. |
|---|---|---|---|---|---|---|---|
| | | | 1793 | 6423 | | | |
| J501 | 1793 Connector, IEEE | H-3 | A-3 | -- | AMP | 552791-1 | CS-377 |
| J501 | 6423 Connector, IEEE | H-3 | -- | B-3 | TRW | 222-22-24-100 | CS-324 |
| J1003B | Connector Hsg, Female, 3 pin (Contacts CS-276) | B-1 | B-2 | C-5 | MOL | 2139-3 | CS-287-3 |
| K501 | Relay, 5V, Reed Type | B-4 | C-3 | D-3 | COT | UF-40097 | RL-56 |
| P1003A | Connector, Male, 3 Pin | A-1 | B-3 | C-3 | MOL | 09-75-1031 | CS-379-3 |
| P1008 | 1793 Cable Assembly | A-4 | D-1 | -- | K-I | -- | 27961A-1 |
| P1008 | 6423 Cable Assembly | A-4 | -- | E-1 | K-I | -- | 27961A-2 |
| R501 | 150Ω, 5%, 1/4W, CarbF | C-5 | D-3 | E-2 | MEP | CR-25* | R-76-150 |
| R502 | 10KΩ, 5%, 1/4W, CarbF | C-6 | E-3 | F-2 | MEP | CR-25* | R-76-10K |
| R503 | 100KΩ,5%, 1/4W, CarbF | C-6 | E-3 | F-3 | MEP | CR-25* | R-76-100K |
| R504 | 2,4KΩ, 5%, 1/4W, CarbF | H-4 | C-3 | D-3 | MEP | CR-25* | R-76-2.4K |
| R505 | 2.4KΩ, 5%, 1/4W, CarbF | H-5 | C-3 | D-3 | MEP | CR-25* | R-76-2.4K |
| R506 | 6.2KΩ, 5%, 1/4W, CarbF | H-4 | C-3 | D-3 | MEP | CR-25* | R-76-6.2K |
| R507 | 6.2KΩ, 5%, 1/4W, CarbF | H-6 | C-3 | D-3 | MEP | CR-25* | R-76-6.2K |
| R508 | 100KΩ, 5%, 1/4W, CarbF | C-6 | D-3 | E-3 | MEP | CR-25* | R-76-100K |
| R509 | 150KΩ, 5%, 1/4W, CarbF | D-6 | D-3 | E-3 | MEP | CR-25* | R-76-150 |
| R510 | 10KΩ, 5%, 1/4W, CarbF | C-6 | D-3 | E-3 | MEP | CR-25* | R-76-10K |
| R511 | 10KΩ, 5%, 1/4W, CarbF | D-6 | D-3 | E-3 | MEP | CR-25* | R-76-10K |
| R512 (A-I) | 10KΩ, 5%, Thick Film | Several | E-5 | F-5 | K-I | -- | TF-99 |
| R513 | 56KΩ, 5%, 1/4W, CarbF | E-5 | D-5 | E-5 | MEP | CR-25* | R-76-56K |

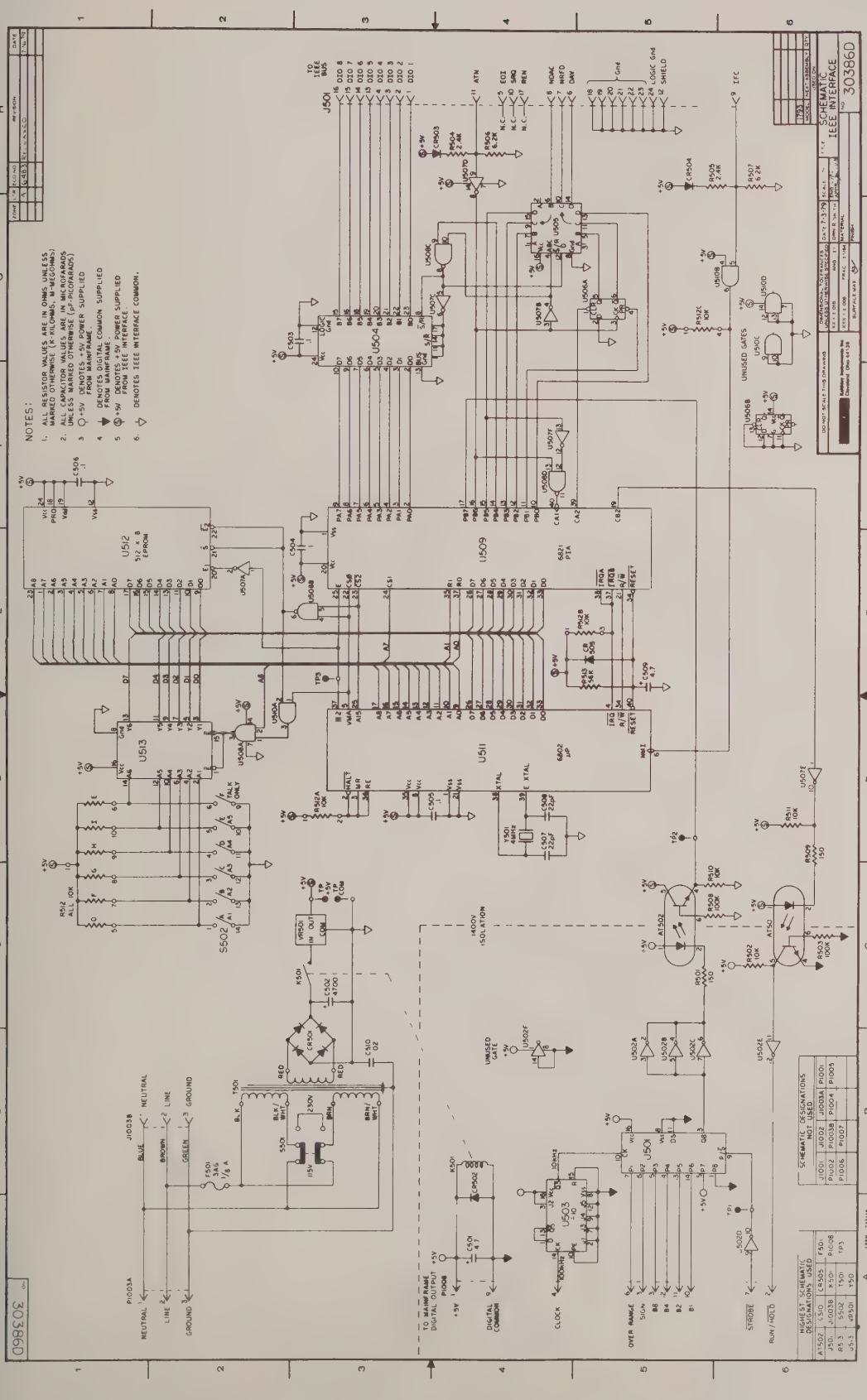
TABLE 6-1
Replaceable Parts List (Cont'd)

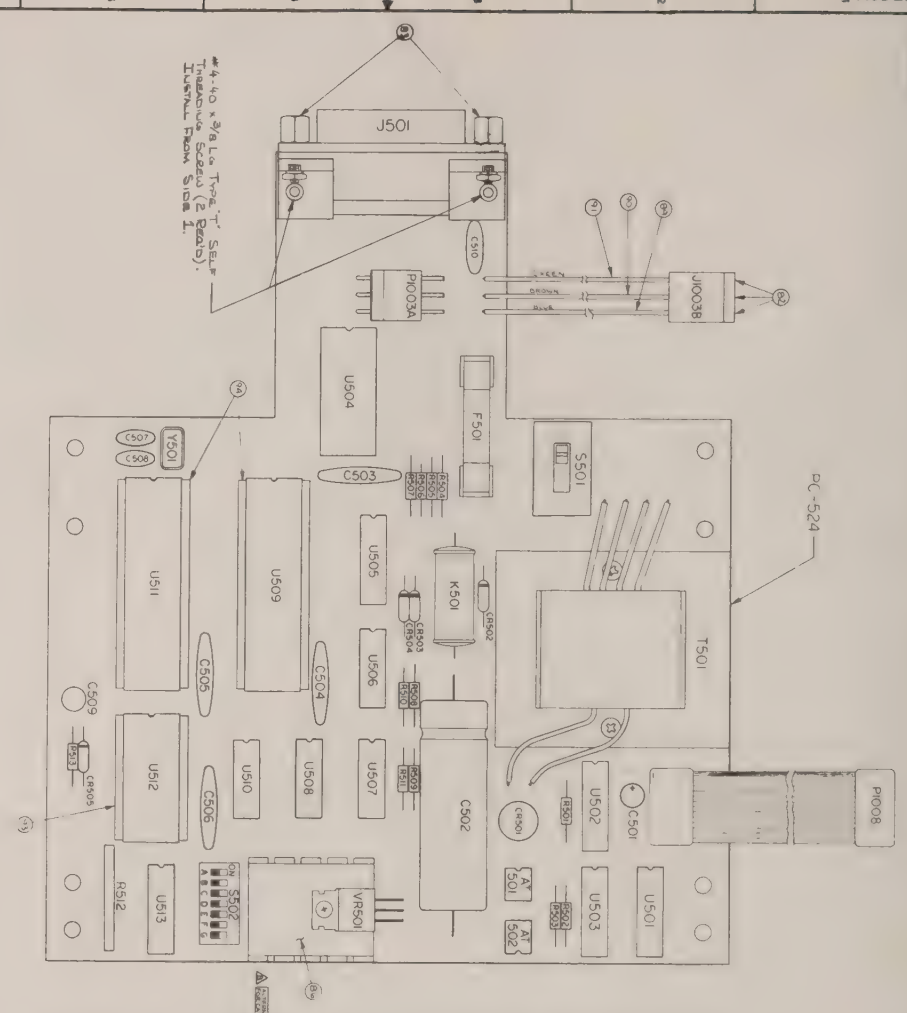
| Circuit Desig. | Description | Schematic Location | PC-Board Location | | Mfr. Code | Mfr. Desig. | Keithley Part No. |
|---|---|---|---|---|---|---|---|
| | | | 1793 | 6423 | | | |
| S501 | Switch, Slide, Line Voltage Select | B-3 | C-2 | D-2 | C-W | GF326-0006 | SW-397 |
| S502 | Switch, Dip | C-2 | E-4 | F-4 | CTS | CTS206-7 | SW-377 |
| T501 | Transformer, Power | B-2 | C-2 | E-2 | K-I | -- | TR-178 |
| U501 | IC,CMOS, 8-Stage, Static Shift Register | B-5 | E-2 | F-2 | RCA | CD4021AE | IC-130 |
| U502 | IC, CMOS, Hex Inverter | Several | D-2 | E-2 | RCA | CD4049AE | IC-106 |
| U503 | IC, CMOS, Presettable, divide by N Counter | A-4 | E-2 | F-2 | RCA | CD4018AE | IC-145 |
| U504 | IC, Bus Transceiver, Octal Bidirectional | G-3 | B-4 | C-4 | MOT | MC3447P | IC-229 |
| U505 | IC, Bus Tranceiver, Quad Interface | G-4 | C-4 | D-4 | MOT | MC3446AP | IC-134 |
| U506 | IC, Flip Flop, Dual "D" | F-6,G-5 | D-4 | E-4 | T-I | 74LS74N | IC-144 |
| U507 | IC, Hex, Inverting Schmitt Trigger | Several | D-4 | E-4 | T-I | SN7414N | IC-153 |
| U508 | IC, Quad 2-Input NAND gate | Several | D-4 | E-4 | T-I | 74LSØØ | IC-163 |
| U509 | Peripheral Interface Adapter | E-4 | C-4 | D-4 | AMI | S6821L | LSI-8 |
| U510 | IC, Quad, 2-Input AND gate | Several | D-4 | E-4 | T-I | 74LSØ8 | IC-215 |
| U511 | 8 Bit Microprocessor | D-4 | C-5 | D-5 | MOT | MC6802 | LSI-18 |
| U512 | Programed, IC-220 for 1793/6423 | E-1 | D-5 | E-5 | K-I | Special | PRO-103-00 |
| U513 | IC, Hex 3-State Buffer | D-1 | E-5 | F-5 | T-I | 74-LS367 | IC-161 |
| VR501 | +5V Voltage Regulator, 3 terminal | C-3 | E-4 | F-4 | MOT | MC7805CP | IC-93 |
| Y501 | Crystal, 4.0 MHz | D-4 | C-5 | D-5 | CTS | MP040 | CR-10 |

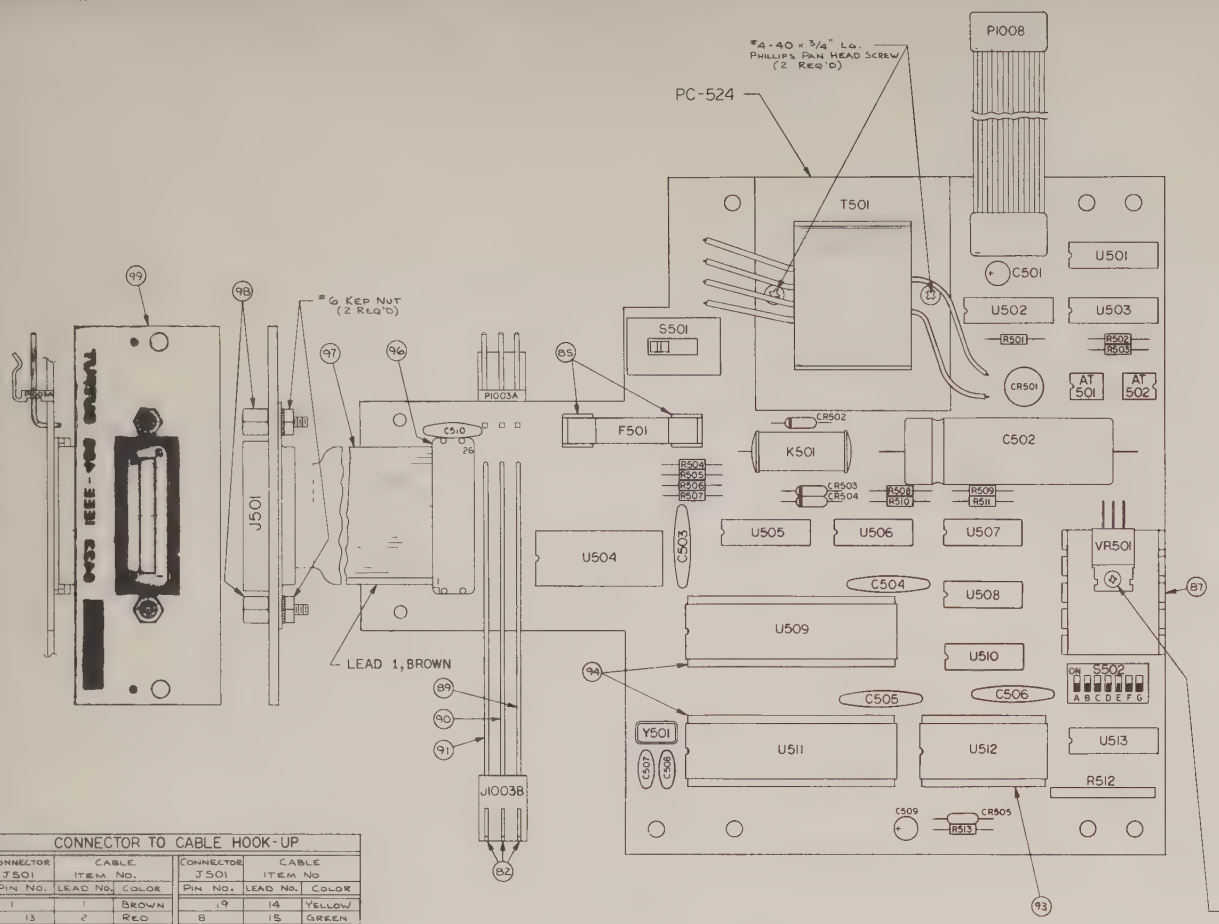
* Manufacturer's Designation includes part description.

TABLE 6-2
Cross Reference of Manufacturers

| MFR. CODE | NAME AND ADDRESS | FEDERAL SUPPLY CODE |
|---|---|---|
| A-P | A-P Products<br>Painesville, OH | |
| AMI | American Microsystems, Inc.<br>Santa Clara, CA 95051 | 31471 |
| AMP | Amphenol<br>Broadview, IL 60153 | 02660 |
| BUS | Bussman Mfg. Div.<br>St. Louis, MO 63017 | 71400 |
| C-W | Continental-Wirt Electronic Corp.<br>Warminster, PA 18974 | 79727 |
| CAI | Callins Industries<br>Greenfield, TN 38230 | 06643 |
| CLB | Centralab Division<br>Milwaukee, WI 53201 | 71590 |
| CTS | CTS Corporation<br>Elkart, IN 46514 | 71450 |
| ERI | Erie Technological Products<br>Erie, PA 16512 | 72982 |
| F-I | Fairchild Instrument Corp.<br>Mountain View, CA 94043 | 07263 |
| G-I | General Instrument Corp72699<br>Newark, NJ 07104 | 72699 |
| ITT | ITT Components<br>Lawrence, MA | 15238 |
| K-I | Keithley Instruments, Inc.<br>Cleveland, OH 44139 | 80164 |
| MEP | Mepco, Inc.<br>Morristown, NJ | 80031 |
| MOL | Molex<br>Downers Grove, IL 60515 | 27264 |
| MOT | Motorola Semi Products, Inc.<br>Phoenix, AZ 85008 | 04713 |
| RCA | RCA Corporation<br>Morristown, NJ 08050 | 02734 |
| T-I | Texas Instruments, Inc.<br>Dallas, TX 75231 | 01295 |
| TRW | TRW - Cinch Con. Operations<br>Elk Grove Village, IL 60007 | 71785 |


SCHEMATIC IEEE INTERFACE
30386D
NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS UNLESS MARKED OTHERWISE (K=KILOHMS, M=MEGOHMS)
2. ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS MARKED OTHERWISE (pF-PICOFARADS)
3. +5V DENOTES +5V POWER SUPPLIED FROM MAINFRAME
4. DENOTES DIGITAL COMMON SUPPLIED FROM MAINFRAME
5. +5V DENOTES +5V POWER SUPPLIED FROM IEEE INTERFACE.
6. DENOTES IEEE INTERFACE COMMON.
J501
TO IEEE BUS
U504
U509
6821 PIA
U511
6802 μP
U512
512 x 8 EPROM
U513
U503
U507
U508
U510
U502
A1502
A1501
S502
S501
T501
J1003B
P1003A
NEUTRAL
LINE
GROUND
BLUE
BROWN
GREEN
115V
230V
RED
BLK
WHT
BRN
TO MAINFRAME DIGITAL OUTPUT
DIGITAL COMMON
CLOCK
OVER RANGE
SIGN
B8
B4
B2
B1
STROBE
RUN / HOLD
UNUSED GATES
SCHEMATIC DESIGNATIONS NOT USED
HIGHEST SCHEMATIC DESIGNATIONS USED
IBM 73119


J501
J1003B
P1003A
U504
F501
S501
C503
U511
U509
U505
K501
T501
PC-524
U506
C504
C505
C509
U512
U510
U508
U507
C502
C506
U502
C501
P1008
U503
U501
U513
R512
S502
VR501
Y501
C507
C508
C510
#4-40 x 3/8 L.g. Type "T" Self Tapping Screw (2 Reqd). Install From Side 1.




| ITEM | PART NO. | SCHEM. DESIG. | ZONE |
|---|---|---|---|
| | 30495B | PC-524 | D1 |
| 2 | | | |
| 3 | IC-82 | AT501 | F3 |
| 4 | " | AT502 | F3 |
| 5 | | | |
| 6 | C-179-4.7 | C501 | E2 |
| 7 | C-290-4100 | C502 | E3 |
| 8 | C-238-.1 | C503 | D4 |
| 9 | " | C504 | E4 |
| 10 | " | C505 | E4 |
| 11 | " | C506 | E4 |
| 12 | C22-22pF | C507 | D5 |
| 13 | " | C508 | D5 |
| 14 | C-179-4.7 | C509 | E5 |
| 15 | C-72-.02 | C510 | C3 |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | RF-46 | CR501 | E3 |
| 20 | RF-28 | CR502 | D3 |
| 21 | " | CR503 | D3 |
| 22 | " | CR504 | B3 |
| 23 | " | CR505 | E5 |
| 24 | | | |
| 25 | FU-20 | F501 | C3 |
| 26 | | | |
| 27 | CS-324 | J501 | B3 |
| 28 | CS 287-3 | J1003B | C5 |
| 29 | | | |
| 30 | RL-56 | K501 | |
| 31 | | | |
| 32 | CS-379 3 | P1003A | C3 |
| 33 | CA-91Z | | |
| 34 | 219618-2 | P1008 | E1 |
| 35 | R-76-150 | R501 | E2 |
| 36 | R-76-10K | R502 | F2 |
| 37 | R-76-100K | R503 | F3 |
| 38 | R-76-2.4K | R504 | D3 |
| 39 | " | R505 | D3 |
| 40 | R-76-6.2K | R506 | D3 |
| 41 | " | R507 | D3 |
| 42 | R-76-100K | R508 | E3 |
| 43 | R-76-150 | R509 | E3 |
| 44 | R-76-10K | R510 | E3 |
| 45 | " | R511 | E3 |
| 46 | TF-99 | R512 | F5 |
| 47 | R 76-56K | R513 | E5 |
| 48 | | | |
| 49 | | | |
| 50 | | | |

| ITEM | PART NO. | SCHEM DESIG | ZONE |
|---|---|---|---|
| 51 | SW-397 | S501 | D2 |
| 52 | SW-377 | S502 | F4 |
| 53 | | | |
| 54 | TR-178 | T501 | E2 |
| 55 | | | |
| 56 | | | |
| 57 | | | |
| 58 | | | |
| 59 | | | |
| 60 | | | |
| 61 | | | |
| 62 | IC-130 | U501 | F2 |
| 63 | IC-106 | U502 | E2 |
| 64 | IC-145 | U503 | F2 |
| 65 | IC-229 | U504 | C4 |
| 66 | IC-134 | U505 | D4 |
| 67 | IC-144 | U506 | E4 |
| 68 | IC-153 | U507 | E4 |
| 69 | IC-163 | U508 | E4 |
| 70 | LS1-8 | U509 | D4 |
| 71 | IC-215 | U510 | E4 |
| 72 | LS1-18 | U511 | D5 |
| 73 | PRO-103-00 | U512 | E5 |
| 74 | IC-161 | U513 | F5 |
| 75 | | | |
| 76 | | | |
| 77 | | | |
| 78 | C 93 | VR501 | F4 |
| 79 | | | |
| 80 | CR-10 | Y501 | D5 |
| 81 | | | |
| 82 | CS-276 3/0 | ~ | C5 |
| 83 | | | |
| 84 | | | |
| 85 | FH-12 2/0 | ~ | C3 |
| 86 | | | |
| 87 | HS-15 | ~ | F4 |
| 88 | | | |
| 89 | SC-71 | BLUE | C4 |
| 90 | SC-71 | BROWN | C5 |
| 91 | SC-71 | GREEN | C5 |
| 92 | | | |
| 93 | SO-68 | ~ | E5 |
| 94 | SO-84-40 3/0 | ~ | C4 |
| 95 | | | |
| 96 | CS-296 | ~ | B3 |
| 97 | SC-67-26 | 4in Lg | B3 |
| 98 | Z8017A | Z/U | B3 |
| 99 | 30496A | ~ | A2 |
| 100 | | | |

## CONNECTOR TO CABLE HOOK-UP

| CONNECTOR J501 PIN NO. | CABLE ITEM NO. LEAD NO. | COLOR | CONNECTOR J501 PIN NO. | CABLE ITEM NO LEAD NO. | COLOR |
|---|---|---|---|---|---|
| 1 | 1 | BROWN | 19 | 14 | YELLOW |
| 13 | 2 | RED | 8 | 15 | GREEN |
| 2 | 3 | ORANGE | 20 | 16 | BLUE |
| 14 | 4 | YELLOW | 9 | 17 | VIOLET |
| 3 | 5 | GREEN | 21 | 18 | GRAY |
| 15 | 6 | BLUE | 10 | 19 | WHITE |
| 4 | 7 | VIOLET | 22 | 20 | BLACK |
| 16 | 8 | GRAY | 11 | 21 | BROWN |
| 5 | 9 | WHITE | 23 | 22 | RED |
| 17 | 10 | BLACK | 12 | 23 | ORANGE |
| 6 | 11 | BROWN | 24 | 24 | YELLOW |
| 18 | 12 | RED | N.C. | 25 | GREEN |
| 7 | 13 | ORANGE | N.C. | 26 | BLUE |

| ZONE | LTR | ECO NO | REVISION | DATE |
|---|---|---|---|---|
| | A | 6370 | RELEASED | 10-1-79 |

| | | | |
|---|---|---|---|
| 6423 | | | |
| MODEL | NEXT ASSEMBLY | QTY USED ON | |

DO NOT SCALE THIS DRAWING — DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED: XX = ± .01, ANG = ±1°, XXX = ± .005, FRAC = ±1/64, SURFACE MAX 63 — DATE 8-1-79 — SCALE 2-1 — DRN R. SMITH — ENG APPR. — MATERIAL ~ — FINISH ~

TITLE: COMPONENT LAYOUT, PC-524

NO 30494D

Keithley Instruments Inc. Cleveland Ohio 44139

FORM 205110

KEITHLEY

**Keithley Instruments, Inc.**/28775 Aurora Road/Cleveland, Ohio 44139/(216) 248-0400/Telex: 98-5469

**Keithley Instruments GmbH**/Heiglhofstrasse 5/D-8000 Munchen 70/(089) 714-40-65/Telex: 521 21 60

**Keithley Instruments, Ltd.**/1, Boulton Road/GB-Reading, Berkshire RG2 ONL/(0734) 86 12 87

**Keithley Instruments SARL**/44, Rue Anatole France/F-91121 Palaiseau Cedex/01-014-22-06/Telex: (842) 204188